CHunt_Assignment2_PS1_PS2

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Problem Set 1

1. Show that $A^TA \neq AA^T$ in general. (Proof and demonstration.)

If A is a 3x2 matrix then A^T is a 2x3 matrix.

$$\begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{d1} & x_{d2} & \dots & x_{dn} \end{bmatrix}$$

For the matrix A below

```
A <- matrix(c(1,2,3,4,5,6), nrow=2, ncol=3)
A
```

```
##      [,1] [,2] [,3]
## [1,]    1    3    5
## [2,]    2    4    6
```

The inverse of this matrix is

```
t(A)
```

```
##      [,1] [,2]
## [1,]    1    2
## [2,]    3    4
## [3,]    5    6
```

2. For a special type of square matrix A, we get $A^TA \neq AA^T$. Under what conditions could this be true? (Hint: The Identity matrix I is an example of such a matrix).

When

$A^TA \neq AA^T$

For Reference Only

> For any matrix, we can define a special operation called the transpose. Given a matrix A, we define its transpose, AT as a matrix whose rows are the columns of A and vice versa. So, if A is m × n, AT is n × m. When you have two vectors x and y, we can consider them as essentially two n × 1 matrices. From this perspective, the dot-product between x and y is simply a matrix multiplication between x T and y. x Tis 1 × n and y is n × 1 producing a 1 × 1 product. Therefore x · y is also be written as x T y.

Problem Set 2

Matrix factorization is a very important problem. There are supercomputers built just to do matrix factorizations. Every second you are on an airplane, matrices are being factorized. Radars that track flights use a technique called Kalman filtering. At the heart of Kalman Filtering is a Matrix Factorization operation. Kalman Filters are solving linear systems of equations when they track your flight using radars. Write an R function to factorize a square matrix A into LU or LDU, whichever you prefer. Please submit your response in an R Markdown document using our class naming convention, E.g. LFulton_Assignment2_PS2.png You don't have to worry about permuting rows of A and you can assume that A is less than 5x5, if you need to hard-code any variables in your code. If you doing the entire assignment in R, then please submit only one markdown document for both the problems.